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Program Overview

Metro Wastewater Reclamation District (Metro District) applies biosolids to their properties near Deer Trail, Colorado. These biosolids applications could affect the quality of water in alluvial and bedrock aquifers, streambed sediments, soils, and crops. Water quality can be directly affected through:

- Contaminated recharge water, or
- Infiltration of water through contaminated soils or sediments (remobilization).

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USGS

The U.S. Geological Survey is a science organization that provides the Nation with reliable, impartial information to describe and understand the Earth. The national USGS home page: <http://www.usgs.gov>

This USGS program:

The Internet address for this program, including links for data and reports, is:

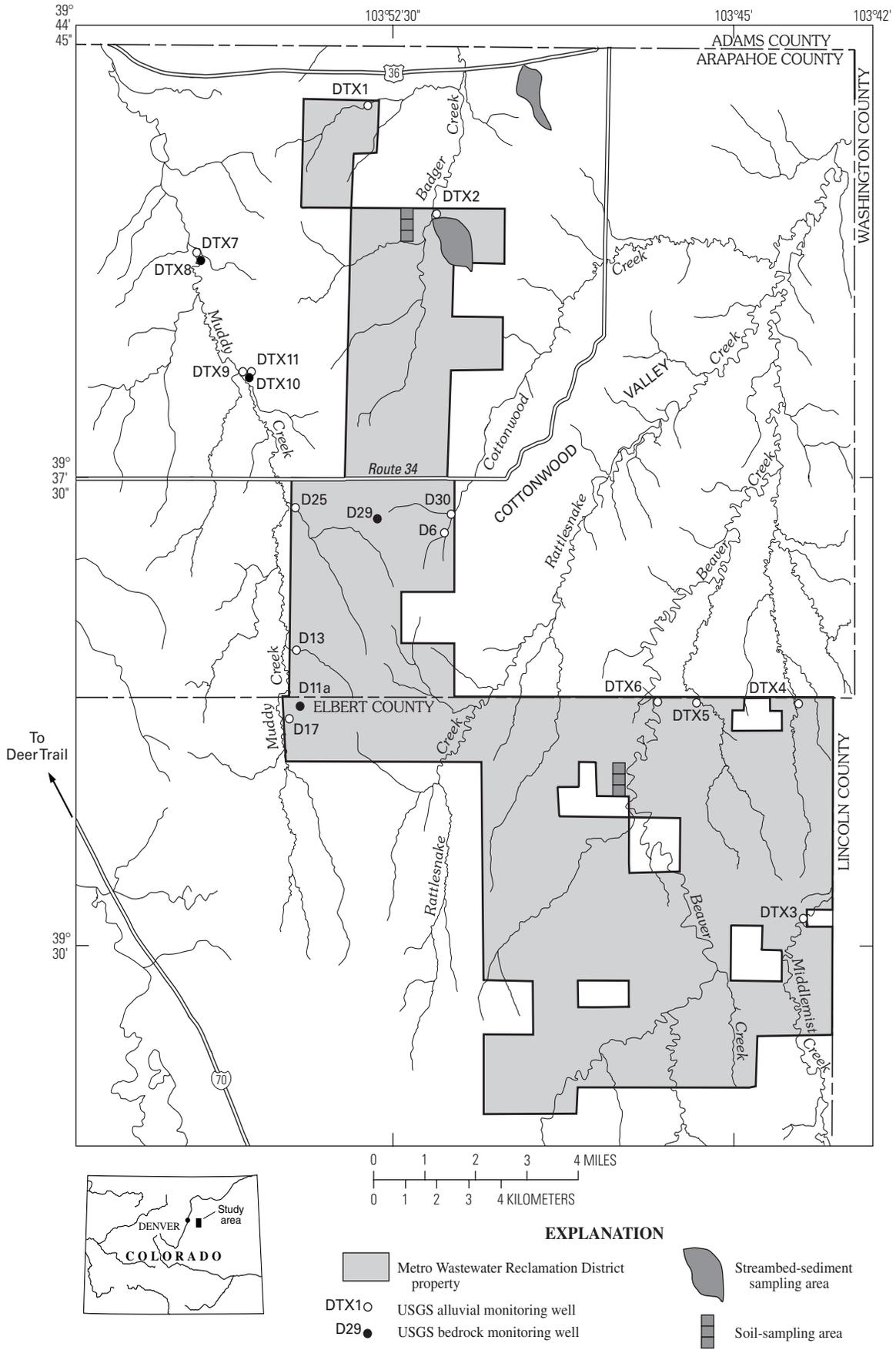
<http://co.water.usgs.gov/projects/CO406/CO406.html>

The Internet address for just the data is:

<http://co.water.usgs.gov/projects/CO406/data.html>
or <http://water.usgs.gov/co/nwis>



Well DTX4 (shown above) became dry (no ground water in the well) in 2001. The well recharged periodically, so a water-quality sample was collected in 2003. In contrast, well DTX3 became dry in early 2004 and did not recharge during 2004. No water-quality samples could be collected from well DTX3 after January 2004.



USGS Expanded Monitoring Program sites and Metro District's biosolids-application properties (1999 property boundaries) near Deer Trail, Colorado.

Program Overview

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Water quality can be indirectly affected through:

- Tilling that mobilizes or changes subsurface chemical constituents, or
- Contributions to natural processes such as nitrification.

Contaminated ground water or surface water could contaminate:

- Other aquifers, such as bedrock water-supply aquifers or alluvial aquifers,
- Other surface-water bodies (ponds or streams), or
- Streambed sediments.

Biosolids must meet metals and radioactivity regulations, or else agro-nomic loading rates will be incorrect and soils could be overloaded. Soil quality could either be improved by biosolids applications through increased nutrients and organic matter, or degraded through excessive nutrients or metals.

The U.S. Geological Survey (USGS) has designed and begun a new monitoring program to address concerns from a stakeholder group about the biosolids and the quality of the environment in the vicinity of the biosolids-application areas. The new USGS monitoring program near Deer Trail is referred to as the “USGS

Expanded Monitoring Program” and began in January 1999.

This monitoring program is distinct from, but builds on, another USGS program that monitored shallow ground-water quality on the Metro District Central Farm from 1993–98. The new program (1999–2005) considers environmental-quality issues for shallow and deep ground water, surface water (streambed sediments), biosolids, soils, and crops. The new expanded monitoring program includes all three Metro District properties (North, Central, and South Farms) and related private-property locations. Both programs, however, use USGS and Metro District funds. In addition, the new monitoring program also uses funds from the North Kiowa Bijou Groundwater Management District. Both programs are designed, carried out, and interpreted independently by USGS, and quality-assured USGS data and reports will be released to the public and the Metro District at the same time. By definition and design, all USGS monitoring programs are independent and unbiased.

The objectives of the new Expanded Monitoring Program are to: (1) Evaluate the combined effects of biosolids applications, land use, and natural processes on alluvial aquifers, the bedrock aquifer, streambed sediments, soils, and crops by comparing chemical data to

- State or Federal regulatory limits,

- Data from a site where biosolids are not applied (a control site), or
- Earlier data from the same site (trends).

(2) Monitor biosolids for metals and radioactivity, and compare the concentrations with regulatory limits. (3) Determine the aquifer hydrology in this area.

The approach is unique for each component of the Expanded Monitoring Program. However, appropriate USGS methods and technologies will be applied to each component.

Progress reports such as this one were prepared quarterly for the first 2.5 years of the program and now are prepared twice each year and distributed to the stakeholders and other concerned people, as well as available to the general public on the Internet (<http://co.water.usgs.gov>). Each progress report will summarize progress from the previous quarters and plans for the current quarters; chemical data will be included twice each year. A USGS report will be prepared annually and made available after each year of the monitoring program: the reports will include data for that year, any interpretations for that year, and statistical analysis for the data to date. A comprehensive USGS report will be prepared and available after five years of monitoring that includes complete statistical analyses and interpretations. In addition, the USGS will meet with the stakeholders once a year to discuss the Expanded Monitoring Program results and to consider possible changes to the Expanded Monitoring Program.

Questions & Answers

Q: What is the status of USGS reports for the study area near Deer Trail?

A: The annual data reports for 1999 and 2000 are published and available. Also published and available is an interpretive hydrogeology report that includes the structure maps done as part of the bedrock ground-water monitoring component. Contact Tracy Yager at the USGS (see page 12) to obtain copies. The annual data reports for 2001 and 2002–2003 are written with some reviews completed, but waiting for USGS approval and printing. The interpretive report for 1999–2003 has been written and is in review. The interpretive water-quality report for 1993–99 has been written and is in preparation for further review.

Q: Why were only 9 wells sampled during January–June 2004, and some wells sampled only once (page 8)?

A: The USGS has been conducting an interim monitoring program in cooperation with the Metro District since October 2003. The interim monitoring program includes a scaled-back field effort that enables the USGS to continue collecting some data while focusing on completing reports.

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Alluvial Ground Water

Approach

Six monitoring wells were installed near the Metro District property boundaries in the major alluvial aquifers. These six wells plus five USGS monitoring wells from the previous program were sampled approximately quarterly for full inorganic chemistry and annually for radioactivity 1999–2003. Data will be reviewed and statistically tested for exceedance of regulatory limits and for trends.

Progress Last Period (January–June 2004)

Ground-water levels were measured January 7–9, February 24, April 5–8, May 5, and June 10, 2004. Ground water was sampled for chemistry in January and April 2004. Ground-water data were compiled and reviewed. The hydrogeology report for 1993–99 (which includes data, the structure maps, and interpretations for some sites included in the expanded monitoring program) was printed and distributed. Reviewed draft reports were revised. The remaining reports were written.

Plans for the Current Period (July–December 2004)

Ground-water levels will be measured at least every other month. Ground water at selected sites will be sampled the first month of each quarter, weather permitting. Data will be compiled and reviewed. The annual reports for 2001 and 2002–03 will be approved, printed, and distributed. The interpretive report for 1999–2003 will be reviewed, revised, approved, and printed. A presentation about findings from this program for 1999–2003 will be made to stakeholders (scheduled for

October 12, 2004). The USGS will discuss ideas for future monitoring with stakeholders.

Bedrock Ground Water

Approach

A structure map of the base of the bedrock aquifer was compiled and used to determine locations for two sets of new, paired wells (each pair comprises one alluvial well and one nearby dual-completion bedrock well). The well pairs were installed where both the Muddy Creek alluvial aquifer and the Laramie-Fox Hills aquifer are present (along the margin of the bedrock aquifer) near the Metro District properties. Water-level data from each well pair will be used to determine aquifer hydrology and interaction at those two locations. The two new bedrock wells

(DTX8, DTX10), along with one USGS bedrock well from the previous project (D29), were sampled approximately quarterly for full inorganic chemistry and annually for radioactivity 1999–2003. Data will be reviewed and statistically tested for exceedance of regulatory limits and for trends.

Progress Last Period (January–June 2004)

Ground-water levels were measured January 7–9, February 24, April 5–8, May 5, and June 10, 2004. Ground water was sampled for chemistry in January and April 2004. Ground-water data were compiled and reviewed. The hydrogeology report for 1993–99 (which includes data, the

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Water levels in wells DTX1 and DTX3 have declined since 1999. The USGS looked at culverts (shown above), road improvements, and drainage-basin features in the vicinity of wells DTX1 and DTX3 to see if surficial changes, such as ponding or deposition, could be causing the water-level declines.

Bedrock Ground Water

Continued from page 4

structure maps, and interpretations for some sites included in the expanded monitoring program) was printed and distributed. Reviewed draft reports were revised. The remaining reports were written.

Plans for the Current Period (July–December 2004)

Ground-water levels will be measured at least every other month. Ground water at selected sites will be sampled the first month of each quarter, weather permitting. Data will be compiled and reviewed. The annual reports for 2001 and 2002–03 will be approved, printed, and distributed. The interpretive report for 1999–2003 will be reviewed, revised, approved, and printed. A presentation about findings from this program for 1999–2003 will be made to stakeholders (scheduled for October 12, 2004). The USGS will discuss ideas for future monitoring with stakeholders.



The continuous-recorder data for D25 have not been available on the Internet because one of the instruments stopped working. That instrument has been removed and brought to Denver for repair.



Access to the Metro District property and other property in the study area is restricted. The USGS contacts the appropriate land owner (including the Metro District) before any visit to that property.



Beaver Creek near well DTX6 occasionally flows for at least a day after rain. This is the best location in the study area if we were to obtain a water-quality sample from a stream draining a biosolids-applied site.

Surface Water (Streambed Sediment)

Approach

Surface-water contamination is a concern for the stakeholders, but streams flow off the Metro District properties only during runoff when

surface-water sampling is impractical. Therefore, possible surface-water contamination from metals were evaluated by sampling streambed sediments soon after storms. Two small drainage basins were selected for similar characteristics but

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Surface Water (Streambed Sediment)

Continued from page 5

different land use—one drainage in a biosolids-application field and another drainage in a farmed field (not on the Metro District properties) that does not receive biosolids. A downstream part of each of the two drainage basins was sampled after the same storms, as many as three to four times per year for inorganic constituents (including metals, total nitrogen, and total phosphorous) and organic carbon, and one time per year for radioactive constituents. Data will be reviewed and statistically tested to determine if concentrations are significantly different between the two drainage basins.

Progress Last Period (January–June 2004)

The site was carefully monitored for runoff-producing rainfall. Runoff was not sufficient to enable streambed-sediment sampling during this period. Reviewed draft reports were revised. The remaining reports were written.

Plans for the Current Period (July–December 2004)

The site will be monitored for runoff-producing rainfall. Sampling may take place, depending on the weather. The annual reports for 2001 and 2002–03 will be approved, printed, and distributed. The interpretive report for 1999–2003 will be reviewed, revised, approved, and printed. A presentation about findings from this program for 1999–2003 will be made

to stakeholders (scheduled for October 12, 2004). The USGS will discuss ideas for future monitoring with stakeholders.

Biosolids

Approach

Biosolids samples will be collected as a 24-hour composite from the Metro District plant and analyzed for trace elements and radioactivity through the USGS. Biosolids will be sampled and analyzed once each quarter during most of the program, and once each month for 6 months when the Lowry Landfill Superfund Site water transfer begins. Data will be reviewed and compared to Federal regulatory limits.

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***Grain was harvested from the study area during summer 2004.
The USGS has samples of this grain for later analysis.***

Biosolids

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Progress Last Period (January–June 2004)

Biosolids samples were collected each month. Each sample was a 24-hour composite from the conveyor belt at the Metro District facility. The material was placed in two acid-washed, one-gallon plastic or glass bottles and transported to the USGS in Denver. There, the samples were air-dried then ground to less than 150 micrometers. Chemical analyses were completed and compiled for all biosolids samples collected from August 2003 through January 2004. Reviewed draft reports were revised. The remaining reports were written.



The USGS has an apparatus to test pressure transducers at the Denver Federal Center. This apparatus will be used to test the equipment removed from D25.

Plans for the Current Period (July–December 2004)

Selected biosolids samples collected after January 2004 will be submitted for chemical analysis. The annual reports for 2001 and 2002–03 will be approved, printed, and distributed. The interpretive report for 1999–2003 will

be reviewed, revised, approved, and printed. A presentation about findings from this program for 1999–2003 will be made to stakeholders (scheduled for October 12, 2004). The USGS will discuss ideas for future monitoring with stakeholders.

Soils

Approach

One site was selected for characterizing and monitoring the chemical composition of soil on the Metro District property in Arapahoe County, and one site was selected on the Metro District property in Elbert County. Each site consists of three 20-acre (933 feet by 933 feet) fields separated by 100-foot buffer zones. The center 20-acre field at each site will have biosolids applied after the initial soil sampling. The other two 20-acre fields at each site will not have biosolids applied and will be used as “control” fields to monitor the natural variability of soil composition for the duration of the study. All three 20-acre fields at each site will be farmed in the normal fashion and have crops planted and harvested. Soils from each of the six fields will be sampled before biosolids are applied to the two center fields and then again after each harvest 1999–2003. Samples will be analyzed for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and beta activity. Data will be examined after 5 years to determine if concentrations have changed with time.

Progress Last Period (January–June 2004)

All soil geochemical data for the program were compiled and graphs were generated showing how the concentration for each element changed during the course of the current program. Reviewed draft reports were revised. The remaining reports were written.

Plans for the Current Period (July–December 2004)

The annual reports for 2001 and 2002–03 will be approved, printed, and distributed. The interpretive report for

1999–2003 will be reviewed, revised, approved, and printed. A presentation about findings from this program for 1999–2003 will be made to stakeholders (scheduled for October 12, 2004). The USGS will discuss ideas for future monitoring with stakeholders.

Crops

Approach

Crops from each of the six 20-acre soil-monitoring fields will be chemically analyzed after harvest. Analyses will include arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc.

Progress Last Period (January–June 2004)

Data were compiled. Reviewed draft reports were revised. The remaining reports were written.

Plans for the Current Period (July–December 2004)

The remaining reports will be reviewed, revised, approved, printed, and distributed. A presentation about findings from this program for 1999–2003 will be made to stakeholders (scheduled for October 12, 2004), and future monitoring will be discussed.

If you have changes to the mailing list, please contact the Elbert County Environmental Health Officer (see page 12) or Tracy Yager (see page 12). Elbert County maintains the mailing list for these reports and for all meeting notices.

If you have questions about the Expanded Monitoring Program, please contact Tracy Yager (see page 12). Commonly asked questions will be included in each Progress Report.

USGS ground-water data, January–June 2004

[Data are preliminary and subject to revision. Standards from Colorado Department of Public Health and Environment, 1997, Basic standards for ground water, 5CCR 1002-41: July 14, 1997, 56 p. All data from filtered samples; mg/L, milligrams per liter; µg/L, micrograms per liter; <, less than; E, value estimated by laboratory]

Well (page 2)	Sample date	Nitrate plus nitrite as nitrogen, mg/L	Arsenic, µg/L	Cadmium, µg/L	Chromium, µg/L	Copper, µg/L	Lead, µg/L	Mercury, µg/L	Molybdenum, µg/L	Nickel, µg/L	Selenium, µg/L	Zinc, µg/L
DTX3	01/08/2004	3.41	1.6	<0.04	<0.8	5.8	<0.08	<0.02	0.7	5.08	22.1	2
DTX5	04/05/2004	.64	.3	.04	<.8	5.8	.12	<.02	1.9	11.4	.7	3
DTX6	04/06/2004	.29	.6	<.08	<.8	12.6	<.16	<.02	E.8	19.6	4.5	6
D29	04/05/2004	.05	.5	<.08	<.8	10.9	<.16	<.02	2.4	21.3	1.5	17
D6	01/08/2004	21.7	8.8	<.28	<1.6	34.9	E.34	<.02	4.1	20.7	33.4	33
D6	04/07/2004	22.9	6.5	<.28	<1.6	49.1	<.56	<.02	3.3	27	48.5	28
D25	01/09/2004	.17	3.5	.21	<.8	15.2	<.16	<.02	7.3	9.88	2.9	6
D25	04/08/2004	.26	1.6	.17	<.8	12.8	<.16	<.02	8.2	15	1.1	7
DTX10A	01/07/2004	.04	.5	<.04	1	5.6	<.16	<.02	1.6	11.5	1.6	4
DTX10A	04/06/2004	<.04	.4	<.08	<.8	8.6	<.16	<.02	1.3	20.3	1.4	4
DTX8A	04/07/2004	<.04	.3	<.04	<.8	3.5	<.08	<.02	.6	7.32	.9	2
DTX2	01/09/2004	<.04	.6	<.04	<.8	8.9	<.08	<.02	1.5	7.32	2.9	7
DTX2	04/08/2004	E.03	1.1	E.05	<.8	10.3	<.16	<.02	1.6	11.1	1.6	7
Human Health Standard		10	10	5	100	1,000	50	2	None	100	50	5,000
Agricultural Standard		100	100	10	100	200	100	10	None	200	20	2,000

USGS biosolids data for samples collected April 2003 through January 2004

[Data are preliminary and subject to revision. Standards from Colorado Department of Public Health and Environment, 1993, Biosolids regulation, 5CCR 1002-64: April 14, 2003. ppm, parts per million; <, less than; pCi/g, picocuries per gram; Pu, plutonium; N.D., not determined; ±, plus or minus the analytical uncertainty]

Sample date	Arsenic, ppm	Cadmium, ppm	Copper, ppm	Lead, ppm	Mercury, ppm	Molybdenum, ppm	Nickel, ppm	Selenium, ppm	Zinc, ppm	Gross Alpha, pCi/g	Gross Beta, pCi/g	Pu238, pCi/g	Pu239+240, pCi/g
April 2003	1.9	2.3	650	51	1.3	38	22	8.7	599	23±3	26±3	0.00±0.00	0.00±0.00
May 2003	2.0	2.5	650	56	1.5	34	22	10	615	N.D.	N.D.	N.D.	N.D.
June 2003	2.4	2.4	700	60	1.3	35	25	12	686	N.D.	N.D.	N.D.	N.D.
July 2003	2.5	2.4	694	58	1.5	34	22	12	709	14±2	24±3	0.00±0.00	0.00±0.00
August 2003	2.8	2.5	694	63	1.8	54	21	10	755	N.D.	N.D.	N.D.	N.D.
September 2003	2.8	2.3	696	62	1.5	60	25	10	738	N.D.	N.D.	N.D.	N.D.
October 2003	2.4	2.4	731	53	1.6	46	23	10	726	N.D.	N.D.	N.D.	N.D.
November 2003	2.1	2.2	676	55	1.3	62	21	8.3	682	N.D.	N.D.	N.D.	N.D.
December 2003	1.9	2.1	613	58	1.3	49	22	8.2	650	N.D.	N.D.	N.D.	N.D.
January 2004	2.0	2.0	607	46	1.5	36	19	7.4	636	N.D.	N.D.	N.D.	N.D.
Maximum Allowable for Grade I	41	39	1,500	200	17.0	75 (Grade II)	420	100	2,800	¹ 40	No standard set	No standard set	No standard set

¹The Colorado regulatory limit on gross alpha activity of 40 pCi/g was removed from the regulation effective June 30, 2003.

Questions & Answers

Continued from page 3

Q: How much longer will the USGS collect data from (sample) the study area near Deer Trail (shown on page 2)?

A: The USGS and the Metro District have agreed to collect and analyze data through December 2004, including quarterly sampling and analysis of biosolids and ground water at selected sites. The USGS and the Metro District currently (August 2004) are discussing future monitoring for the study area. Further discussion of that topic is planned for the next stakeholder meeting in October 2004.

Q: Did the USGS collect streambed-sediment, soil, or crop samples during this period?

A: Rainfall runoff was not sufficient to collect streambed-sediment samples during January through July 2004. Soil from the monitoring fields (shown on page 2) was not sampled during January through July 2004. Crop samples from the summer 2004 harvest on the Metro District property were collected, but not yet analyzed.



The streambed-sediment sampling basin near DTX2 on the Metro District property.



Definitions

Analytical uncertainty—The possible range of the true value or error term contributed by bias and variability of the laboratory measurement technique. All laboratory data have associated uncertainty. Each sample value should be thought of as a range in concentration defined by the reported value plus or minus the analytical uncertainty. The true concentration usually is somewhere in this range, but not a precisely known point. For most analyses, the analytical uncertainty is not calculated for each sample but is estimated from bias and variability data derived from analyses of quality-assurance samples such as blanks and replicates. For radioactivity data, the analytical uncertainty is calculated individually for each sample for each analyte based on analytical and statistical variables.

Biosolids—Solid organic matter recovered from a sewage-treatment process that meets regulatory criteria for beneficial use, such as for fertilizer. Metro District applies Grade I, Class B biosolids at Deer Trail. Regulations require that land-applied biosolids must meet or exceed Grade II, Class B. Grade I exceeds Grade II.

Composited sample—A sample made by combining individual subsamples into a single sample. Each streambed-sediment sample from this program usually is a field-composited sample because the sample contains sediments from more than one depositional area of the streambed.

Less than (<)—A designation for analytical results to indicate that a constituent was not present or was present at very low levels that the laboratory could not reliably determine. Note that the actual amount of this constituent in that sample is unknown and could be any amount between zero and the “less than” value.

Runoff—The rain that hits the ground and flows over the land surface into valleys instead of infiltrating into the soil. Runoff can wash particles of soil, rock, plants, and biosolids from the land surface into the streambeds of the valleys.

Stakeholder—Any person or group (including the Metro District) interested or concerned about the Expanded Monitoring Program.

Contacts

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U.S. Environmental Protection Agency: Bob Brobst, 303–312–6129

Sixth annual stakeholder meeting is scheduled for October 12, 2004, at the Metro Wastewater Reclamation District property near Deer Trail, Colorado

Prepared by Tracy Yager, Dave Smith, and Jim Crock (USGS), in cooperation with Metro Wastewater Reclamation District, August 2004

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